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THEORETIC HINTS
O N
An Improved Practice
O F
BREWING MALT-LIQUORS;
Including some Strictures
O N T H E
Nature and Properties
O F
Water, Malt, and Hops;
The Doctrine of *Fermentation;*
The Agency of *Air;*
The Effects of *Heat and Cold*
On fermented Liquors, &c. &c.

By JOHN RICHARDSON.

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THEORETIC HINTS

An Improved Practice

BREWING MALT-LIQUORS

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PREFACE.

THE design of the Author, in the publication of the subsequent pages, is rather to intimate the probability of a *complete system of brewing*, than to promulgate one. Were he prompted by inclination to the undertaking, his interest would forbid the execution of it. The ordinary emoluments arising from the sale of a book, however extensive, would be a compensation very inadequate to the fatigue of many years wearisome attention

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to the multifarious practice of a brewhouse, employed in the production of almost every species of malt-liquor; or to the trouble of digesting the œconomy of that practice, noting events, investigating causes, and thence forming rules for the regulation and management of future processes. To the ingenious, it is presumed, these hints will not want utility, and to the mind unaccustomed to scientific disquisitions, a more perfect theory, without practical elucidation, might have been inefficacious. To both, in the present instance, the illustration of practice is necessary, where it is the intention of the enquirer perfectly



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perfectly to understand, in order to adopt, the principles upon which the Author's system is founded, to which this publication is designed as preliminary information only.

Such an illustration must be personal, in consequence of special agreement ; * from which it is presumed that the brewery of London might vie with the country in the production of the finer *ales*, whilst the country brewer, in return, might be convinced of the practicability of producing *porter* in his own office, of qualities equal, in every respect, to those of the

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* See the Author's *Advertisement addressed to the Common Brewers.*

same liquor brewed in the metropolis. Locality, in either case, is no further concerned in peculiar qualities (climate only excepted) than what arises from the difference in the nature of the water, which being so large a portion of the product, has indeed a very powerful influence. Yet, by a knowledge of the causes of that influence, we are enabled to make an artificial variation of process supply natural defect, and to prove that common, which was before thought to be peculiar.

From experimental practice in several different parts of the kingdom,

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dom, the Author is convinced of this truth; nor is he less assured, from observations on the continent, of the practicability of producing malt-liquors in all the northern parts of Europe (except where the cold is so intense as to prevent the action of fermentation) in as great perfection as in England. The climate of France, from Paris northward, of the French and Austrian Netherlands, of Holland, and of many parts of Germany, is well adapted to the brewing business, but the brewers know not how to reap the benefit of their situation. Those of Paris are entirely ignorant of the art, as well as that of malting.

malting. Their malts have but just time to germinate, ere they are dried off, whence they have scarce any of the fermentable principles of a perfect malt in them, and are of so steely a consistence as to be hardly penetrable. Under these disadvantages, it is not to be wondered at that their *bonne biere de Mars* is such a miserable beverage. Did they pursue the method of malting inculcated in the following pages, and adopt a proper process of brewing, the same quantity which they now make of wretched beer, for the retail price of six sous the bottle, might be converted into a good porter, which
sells

sells there for 25 sous, or a pleasing pale ale of equal value. And tho' this increase of price might not be entirely or immediately effected, on account of a prejudice common to all nations, of viewing in a secondary light every imitation, however near the original, yet it is uncontrovertible that such a change in the quality, from a thin, ill-flavored, spiritless, to a pleasant, sprightly, vinous liquor, would be productive of emoluments exceeding, beyond all comparison, the expence attending the acquisition; and to consider it in a public light, it will occur to every person, how much more wholesome
and

and invigorating must a sound, nutritious malt-liquor be, than a meagre, hungry, ungenial wine, a liquor next in degree, above the crude, unformed beer here alluded to.

The Flemings, with every local advantage, are not many degrees beyond the French in the art of brewing, tho' malt-liquor is a beverage much more common in Flanders than in France. At Brussels, which some writers have celebrated for its beers, the best to be met with, in common, is of a brownish amber, somewhat strong and transparent, but for want of being brewed by a skillful artist,
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it fails in point of preservation, and turns acid in warm weather. They have another sort, pale and turbid, called *bierre blanche de Louvaine*, which is little better than thick small beer. This being bottled whilst new, is no sooner uncorked than it flies furiously out of the bottle, like beer in the height of fermentation, and is drunk by the Flemings in that state, with much seeming relish, tho' they acknowledge, at the sametime, *it is not so good as English beer.*

The situation of Flanders is exceedingly favorable to the production of malt-liquors, particularly in and about Bruffels. The soil is

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rich

rich and fertile, well cultivated, and produces plenty of very good corn and hops, the latter of which are generally injured by hanging too long upon the plant, and by being gathered slovenly and bagged carelessly. The air is very much like that of many parts of England, and there is a plentiful supply of water, fit for every purpose of the brewer. But the beneficence of Nature will be unavailing, so long as her handmaid, Art, withholds her necessary aid. Were the Flemings to court the liberal dispensation of her favors, and obtain a knowledge of the principles of brewing, they might soon dispute the palm with England,

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in the celebrity of malt-liquors ; for even here, the number of places entitled to any degree of pre-eminent distinction is exceedingly limited, whilst the majority of practitioners do but barely overtop those of Flanders.

This extreme dearth of information, on a subject of such general utility and importance, ought rather to be treated as a misfortune than a fault. Few, very few, of those employed in the practice of a brew-house, have ever been taught to consider brewing in any other than a mere mechanical light. Every master of a country ale-house, every

hostler of a country inn, every servant of a country farmer, pretends to a proficiency in the art, and the man of science is amazed to hear the common brewer dwell upon unaccountable difficulties, in a business practised with seeming ease, even by old women. Nor have those who have taken upon them to write particularly on the subject, done any thing more than jumble together a number of recipes, in the style and manner of a *cookery-book*, or *family physician*, but with somewhat less efficacy. From these, one only may be excepted, who had the misfortune to be too abstrusely philosophical for common comprehension, and refined

refined upon trifles till his theory frittered away the intention of his practice, and the product of both compleated their entire demolition.

The few strictures here submitted to the inspection of the public, are not brought forward as the result of any deep researches into the chymic art, but as the leading principles of an improved system of brewing, founded, indeed, on the established laws of chymistry, but confirmed, in every reciprocal relation of causes and effects, thro' a series of practice of many years continuance.

Hence is the Author enabled to recommend, with confidence, his
theory,

theory, as an illustration of his practice; and his practice, as a confirmation of his theory; at the same time that he proposes an appeal to well-attested facts, as an additional ratification of both.

N. B. Those gentlemen of the brewery in England or Scotland, who have not already received the Author's *Advertisement of proposals for teaching his methods of brewing porter and pale beers*, shall have copies forwarded to their respective addresses, on sending a line, postage free, to *Jos. Coffee House, Mitre Court, Fleet Street, LONDON*; those in Ireland, to James Williams, Bookseller, at DUBLIN, or Thomas White, Bookseller, at CORK.

THEORETICAL HINTS



BREWING.

Of Water

THE general distinction of water, as it respects the common purposes of life, extends no further than the simple terms of *hard* and *soft*; and tho' it may not be in the power of every brewer to pursue his inclination in the choice of them, yet as there are some who can benefit of the distinction, by the possession of both, and as all may profit by the judicious application of either, it may not be amiss to say somewhat by way of discriminating

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criminating their virtues, and pointing out their uses in brewing.

Hard water, is that which being strongly impregnated with certain terrestrial matters, does not easily lather with soap, but causes it to curdle or coagulate, and is in general less fit for culinary purposes. Its specific gravity is greater than that of soft water, whence its virtue as a menstruum is considerably lessened, as is evident by the inferior quality of worts extracted with hard, to those with soft water, *ceteris paribus*; but the experienced brewer, in some measure, guards against this inconvenience, by exposing his water, as much as he can, to the softening virtue of the air, and by varying the extracting heat, which in hard water produces effects at a certain degree, similar to those producible only at a distant degree in soft.

In fermentation we find an equal disadvantage in the use of hard water, which
does

does not so readily incline to that action, whence there is a considerable deficiency in point of spirituousity. As a preservative it may be preferred, on account of its containing some alkaline qualities, which contribute to counteract any tendency to acidity, in the beer, and thence assist in its preservation. Transparency is, also, more easily obtainable by the use of hard water; first, from its inaptitude to extract such an abundance of that light, mucilaginous matter, which, floating in the beer, for a long time occasions its turbidity; secondly, from its greater tendency to a state of quietude, after the vinous fermentation is finished, by which those floating particles are more at liberty to subside; and lastly, from the mutual aggregation of the earthy particles of the water with those of the materials, which, by their greater specific gravity, thus aggregated, not only precipitate themselves, but carry down also that lighter mucilage just mentioned. For these reasons it is not well adapted to the

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brewing

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brewing of porter, and such beers as require a fulness of palate, when drawn to the great lengths of the London brewery, and of some country situations. But we can, by a judicious application of the extracting heat, and a peculiar mode of conducting the action of fermentation, produce from hard water, as far as Art can be the substitute of Nature, those qualities which by unvaried practice are only obtainable from soft.

By *soft water* we mean that which being unburthened with the rigid earths, is of less specific gravity, of more simple taste, and of greater purity, which renders it more capable of entering the pores, and forming a solution of such parts of the materials as yield to the impression of the simple element.

The purity of water is determined by its lightness, and in this distilled water, only, can claim any material degree of perfection.

fection. Rain water is the purest of all, naturally produced; but by the perpetual exhalations of vegetables, and other fine substances floating in the atmosphere, it does not come down to us entirely free of those qualities which pond and riverwaters possess in a greater degree. These, especially of rivers running thro' fens and morasses, from the quantity of grass and weeds growing therein, imbibe an abundance of vegetable solutions, which occasions them to contain more fermentable matter, and consequently to yield a greater portion of spirit, but at the same time induces such a tendency to acidity as will not easily be conquered. This is more to be apprehended towards the latter end of the summer, than at any other season of the year; because these vegetable substances are then in a state of decay, and thence more readily impart their pernicious qualities to the water which passes over them,

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At such an unfavorable time should the brewer be necessitated to pursue his practice, it will behove him to pay the utmost attention to the cause of this disposition in his liquor, and thence endeavor to prevent the ill consequences, by conducting his process to the extraction and combination of such parts of the materials, as his judgment informs him will best counteract its effects.

Where there is the liberty of choice, we would recommend the use of that water which, from natural purity, equally free of the austerity of imbibed earths, and the rankness of vegetable saturation, has a soft fulness upon the palate, is totally flavorless, inodorous, and colorless, whence it is the better prepared for the reception and retention of such qualities as the process of brewing is to communicate and preserve.

Of



THE end of the process of malting is well known, to every one concerned in the making and consumption of malt, to be the production of that *saccharum*, upon which its value so eminently depends; but in the means of accomplishing it, they are not so entirely agreed. In dry barley we find no appearance of this quality; the first efforts of vegetation discover none; let them continue a little longer, and we perceive its gradual production to a certain period; beyond that period it again begins to disappear, and is soon totally lost.

To investigate the causes of these extraordinary changes, were a fruitless enquiry. Philosophy may amuse itself in tracing the imaginary gradation, till it be lost with the principle it pursues. The man of business will here find a better account

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count in noting effects than in attempting to discover causes, which in the productions of Nature will ever be hypothetical, till Art can make the copy like the original,

In the business of malting, similar effects, in different subjects, are not produced at the same time, or in the same apparent state of the grain, but vary according to their several natures and qualities. Thus Indian corn, and all the larger bodied grain is found to require a length of time sufficient to shoot out a considerable acrospire, before the production of its saccharine matter is perfect, whilst that of barley would be entirely destroyed by the same practice.

The process of making malt is an artificial, or forced vegetation, in which the nearer we approach the footsteps of Nature, in her ordinary progress, the more certainly shall we arrive at that perfection of which the subject is capable. The farmer

mer prefers a dry season to sow his corn in, that the common moisture of the earth may but gently insinuate itself into the pores of the grain, and thence gradually dispose it for the reception of the future shower, and the action of vegetation. The maltster cannot proceed by such slow degrees, but makes an immersion in water a substitute for the moisture of the earth, where a few hours infusion is equal to many days employed in the ordinary course of vegetation, and the corn is accordingly removed as soon as it appears fully saturated, lest a solution, and consequently a destruction of some of its parts should be the effect of a longer continuance in water, instead of that separation, which is begun by this introduction of aqueous particles into the body of the grain.

Were it to be spread thin, after this removal, it would become dry, and no vegetation would ensue; but being thrown into

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into the couch, a kind of vegetative fermentation commences, which generates heat, and produces the first appearance of germination. This state of the barley is nearly the same with that of many days continuance in the earth, after sowing, but being in so large a body, it requires occasionally to be turned over, and spread thinner; the former to give the outward parts of the heap their share of the acquired warmth and moisture, both of which are lessened by exposure to the air; the latter to prevent the progress of the vegetative to the putrefactive fermentation, which would be the consequence of suffering it to proceed beyond a certain degree.

To supply the moisture thus continually decreasing by evaporation and consumption, an occasional, but sparing sprinkling of water should be given to the floor, to recruit the languishing powers of vegetation, and imitate the shower upon the corn field. But this should not be too often repeated.

repeated; for as in the field too much rain and too little sun, produce rank stems and thin ears, so here would too much water, and of course too little dry warmth, accelerate the growth of the malt, so as to occasion the extraction and loss of such of its valuable parts, as by a slower process would have been duly separated and left behind.

By the slow mode of conducting vegetation here recommended, an actual and minute separation of the parts takes place. The germination of the radicles and acrospire carries off the cohesive properties of the barley, thereby contributing to the preparation of the saccharine matter, which it has no tendency to extract, or otherwise injure, but to encrease and meliorate, so long as the acrospire is confined within the husk; and by how much it is wanting of the end of the grain, by so much does the malt fall short of perfection, and in proportion as it has advanced beyond, is that purpose defeated.

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This is very evident to the most common observation, on examining a kernel of malt, in the different stages of its progress. When the acrospire has shot but half the length of the grain, the lower part, only, is converted into that mellow saccharine flour we are solicitous of, whilst the other half exhibits no other signs of it, than the whole kernel did at its first germination. Let it advance to two-thirds of the length, and the lower end will not only have encreased its saccharine flavor, but will have proportionally extended its bulk, so as to have left only a third part unmalted. This, or even less than this, is contended for, by many maltsters, as a sufficient advance of the acrospire, which they say has done its business as soon as it has passed the middle of the kernel. But we need seek no further for their conviction of error, than the examination here alluded to.

Let the kernel be slit down the middle and tasted at either end, whilst green, or let the effects of mastication be tried, when
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it is dried off; when the former will be found to exhibit the appearances just mentioned, the latter to discover the unwrought parts of the grain, in a body of stony hardness, which has no other effect in the mash-tun than that of imbibing a large portion of the liquor, and contributing to the retention of those saccharine parts of the malt which are in contact with it; whence it is a rational inference, that three bushels of malt, imperfect in this proportion, are but equal to two of that which is carried to its utmost perfection. By this is meant the farthest advance of the acrospire, when it is just bursting from its confinement, before it has effected its enlargement. The kernel is then uniform in its internal appearance, and of a rich sweetness in flavor, equal to any thing we can conceive obtainable from imperfect vegetation. If the acrospire be suffered to proceed, the mealy substance melts into a liquid sweet, which soon passes into the blade, and leaves the husk entirely exhausted.

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The sweet thus produced by the infant efforts of vegetation, and lost by its more powerful action, revives and makes a second appearance in the stem, but is then too much dispersed and altered in its form, to answer any of the known purposes of art.

The periods of its perfect appearance are, in both cases, remarkably critical. It is at first perfect at the instant the kernel is going to send forth the acrospire and form itself into the future blade; it is again discovered perfect when the ear is laboring at its extrication, and hastening the production of the yet-unformed kernels. In this does it appear the medium principle of Nature's chymistry, equally employed by her in her mutation of the kernel into the blade, and her formation thence of other kernels, by which she effects the completion of that circle to which the operations of the vegetable world are limited.

Were we to enquire, by what means the same barley, with the same treatment, produces unequal portions of the saccharine

rine matter in different situations, we should perhaps find it principally owing to the different qualities of the water used in malting. Hard water is very unfit for every purpose of vegetation, and soft will vary its effects according to the predominating quality of its impregnations. Pure elementary water is in itself supposed to be only the vehicle of the nutriment of plants, entering at the capillary tubes of the roots, rising into the body, and there depositing its acquired virtues, perspiring by innumerable fine pores at the surface, and thence evaporating, by the purest distillation, into the open atmosphere, where it begins anew its round of collecting fresh properties, in order to its preparation for fresh service.

This theory leads us to the consideration of an attempt to encrease the natural quantity of the saccharum of malt by adventitious means; but it must be observed, on this occasion, that no addition to water will rise into the vessels of plants, but such as will pass the filter; the pores of
of

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of which appearing somewhat similar to the fine strainers or absorbing vessels employed by Nature in her nicer operations, we by analogy conclude, that properties so intimately blended with water as to pass the one, will enter and unite with the economy of the other, and *vice versa*.

Supposing the malt to have attained its utmost perfection, according to the criterion here inculcated, to prevent its farther progress, and secure it in that state, we are to call in the assistance of a heat sufficient to destroy the action of vegetation, by evaporating every particle of water, and thence leaving it in a state of preservation fit for the present or future purpose of the brewer.

Thus having all its moisture extracted, and being, by the previous process, deprived of its cohesive property, the body of the grain is left a mere lump of flour, so easily divisible, that the husk being taken off, a mark may be made with the kernel, as with a piece of soft chalk. The extractible qualities of this flour are, a saccharum, closely

closely united with a large quantity of the farinaceous mucilage peculiar to bread corn, and a small portion of oil, enveloped by a fine earthy substance, the whole readily yielding to the impression of water applied at different times and different degrees of heat, and each part predominating in proportion to the time and manner of its application.

In the *curing* of malt, as nothing more is requisite than a total extrication of every aqueous particle, if we had, in the season proper for malting, a solar heat sufficient to produce perfect dryness, it were practicable to produce beers nearly colorless; but that being wanting, and the force of custom having made it necessary to give our beers various tinctures and qualities resulting from fire, for the accommodation of various tastes, we are necessitated to apply such heats in the drying as shall not only answer the purpose of preservation, but give the complexion and property required.

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To effect this, with certainty and precision, the introduction of the thermometer is necessary ; but the real advantages of its application are only to be known from experiment, on account of the different construction of different kilns, the irregularity of the heat in different parts of the same kiln, the depth of the malt, the distance of the bulb of the thermometer from the floor, &c. &c. for tho' similar heats will produce similar effects in the same situation, yet is the dispersion of heat in every kiln so irregular, that the medium spot must be found for the local situation of the thermometer, ere a standard can be fixed for ascertaining effects upon the whole. That done, the several degrees, necessary for the purposes of porter, amber, pale beers, &c. are easily discovered to the utmost exactness, and become the certain rule of future practice.

Tho' custom has laid this arbitrary injunction of variety in our malt-liquors, it may not be amiss to intimate the losses we often sustain, and the inconveniencies

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we combat, in our obedience to her mandate.

The further we pursue the deeper tints of color, by an increase of heat beyond that which simple preservation requires, the more we injure the valuable qualities of the malt. It is well known that scorched oils turn black, and that calcined sugar assumes the same complexion. Similar effects are producible in malts, in proportion to the increase of heat, or the time of their continuing exposed to it. The parts of the whole being so mutually united by nature, an injury cannot be done to the one without affecting the other; accordingly we find, that such parts of the subject as might have been severally extracted, for the purposes of a more intimate union by fermentation, are, by great heat in curing, burnt and blended so effectually together, that all discrimination is lost, the unfermentable are extracted with the fermentable, the integrant with the constituent, to the very great loss both of spirituousity and transparency. In paler

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malts,

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malts, the extracting liquor produces a separation which cannot be effected in brown, where the parts are so incorporated, that unless the brewer be very well acquainted with their several qualities and attachments, he will bring over, with the burnt mixture of saccharine and mucilaginous principles, such an abundance of the scorched oils as no fermentation can attenuate, no precipitants remove; for being in themselves impediments to the action of fermentation, they lessen its efficacy, and being of the same specific gravity with the beer, they remain suspended in and incorporated with the body of it, an offence to the eye, and a nausea to the palate, to the latest period.

Of Hops.

THE chymical principles of vegetables, as far as Art has yet been able to discover, by analysis, are *water, salt, oil, and earth.* These, in different vegetables

tables, do not only abound in different proportions, but vary in their species and properties. The water, being only the general medium of the whole, is the same simple element in all; the oil in some plants is more thin and fluid, in others more gross and viscous; the salt is in some more volatile, in others more fixed, in some acid, in others alkaline; the earth appears to be the mere uncharacteristic residuum of the whole, to which all have relation, and to which all finally return.

In hops, the quantity of oil is abundant; the finer part of an agreeable fragrance and great volatility; the coarser, from its intimate union with an austere saline earth, of the alkaline kind, is grosser in its odour, harsher in its flavor, and less subject to avolation.

The time of picking, the mode of curing, the care in bagging, the place of keeping, all have their share in the preservation or destruction of the finer qualities of this vegetable. If the hop be plucked too early, the consequence of im-

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maturity is obvious; if it hang too late, the constant avolation of its fine unctuous parts, wastes its fragrance, destroys its color, and renders it of less value and efficacy. An application of too much heat in the curing has similar effects; for by evaporating the aqueous parts of the vegetable too hastily, the finer parts of the essential oil rise with them and are lost, whilst the remainder receives an injury somewhat similar to that of malt by the like injudicious treatment. The care in bagging and keeping is equally important, on the same principle of excluding, as much as possible, the action of the external air upon the hop, which carries off its more valuable qualities in the same manner, as by a too long continuance on the plant. The closer they are pressed down in the bag, the more effectual is their security against this injury; and the best practical method of keeping them, is in a close, but dry room, the bags laid upon each other, and the interstices well filled

filled with a dry inodorous matter, such as the first screenings of malt, &c.

Time, however, will impair their virtues, in spite of the utmost precaution, and that so rapidly, as to render them incompetent to the nicer purposes of the pale-ale brewer, after the expiration of the first year, in all the ordinary modes of preserving them.

In these virtues of the hop are we to look for the primary principles of flavor and preservation of malt-liquors, which are to be extracted in such manner and proportion, as to the judgment of the brewer shall seem most likely to answer those intentions. To accomplish this, with certainty and advantage, particular attention must be had to the several ends of extracting, and the different effects of those extracts upon the rest of the process; viz. whether the purpose of flavor will not defeat that of preservation, and whether the too anxious pursuit of preservation will not weaken the powers, and lessen the effect of fermentation, to the very great
loss

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loss of the subject; for it is very certain, that every unctuous principle is an enemy to fermentation, and has a direct tendency to impair its action and destroy its efficacy.

Hence are we taught by reason, what is confirmed by experience, that the soluble parts of the hop, extracted severally, answer several different purposes in beers, but taken collectively, tend to confound their virtues and pervert their uses; and that in their extraction, if the means be not nicely proportioned to the end, the order of the process is destroyed, and the intention of the brewer defeated.

Of Worts.

HAVING taken a cursory view of the materials themselves, we come now to consider more particularly the several modes of applying them, in order to extract their valuable parts, and the different effects of their application, in forming such extracts.

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We have already seen that barley, by a partial vegetation, stopped at a certain period, is converted into *malt*, a friable substance, easily reducible to a mellow flour, the soluble principles of which are, a saccharum, very distinguishable by the senses, intimately united with a mealy, mucilaginous matter, and a small portion of oil enveloped by an earth.

The quality of the saccharine part resembles that of common sugar, to which it is practicable to reduce it, and its characteristical properties are entirely owing to its intimate connection with the other parts of the malt, from which such distinguishing flavors of beers are derived, as are not the immediate result of the hop. Were it not for these properties, the brewer might adopt the use of sugar, molasses, honey, or the sweet of any vegetable, to equal advantage, which cannot now be done, unless an eligible succedaneum be found to answer that purpose. As we are at present circumstanced, a search on the other side would turn more to the brewer's account.

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account. We have in malt a superabundance of the grosser principles, and would government permit the introduction of a foreign addition to the saccharine, which is too deficient, many valuable improvements might be made from it; as we could, by a judicious application of such adventitious principle, produce a second and third wort of quality very little inferior to the first.

But in these experiments, a very particular attention would be necessary to the solvent powers of the water at different degrees of heat, and to the enquiry, How far a menstruum already saturated with one principle, may be capable of dissolving another? Such a consideration is the more necessary on this occasion, to direct us clear of two extremes equally disagreeable: the first is, that of applying the menstruum pure, and at such a heat as to bring off an over proportion of the oleaginous and earthy principles, which would occasion in the beer, thus wanting its share of natural saccharum, a harshness and austeri-

sterity, which scarce any time the brewer could allow would be able to dissipate; the other is, that of previously loading the menstruum with the adopted sweet, in such an abundance, as to destroy its solvent force upon the characteristical qualities we wish to unite with it, and thereby leave it a meer solution of sugar. The requisite mean is that of considering, what portion of the saccharine quality has been extracted in the first wort, according to the quantity of water and degree of heat applied, and then to make such a previous addition of artificial sweet as will just serve to counterbalance the deficiency, and assimilate with that portion of the remaining principles, we are taught to expect will be extracted with the succeeding wort.

From the nature of the constituent principles of malt, it is easy to conceive that the former, or saccharine and mucilaginous parts, yield most readily to the impression of water, and that at so low a degree of heat, as would have no visible effect upon the latter. If, therefore, we

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are to have a certain proportion of every part, it is a rational inference that the means of obtaining it, rests in a judicious variation of the extracting heat, according to the several proportions required.

A low degree of heat, acting principally upon the saccharum, produces a wort replete with a rich, soft sweet, fully impregnated with its attendant mucilage, and in quantity much exceeding that obtainable from increased heat; which, by its more powerful insinuation into the body of the malt, acting upon all the parts together, extracts a considerable portion of the oleaginous and earthy principles, but falls short in softness, fullness, sweetness, and quantity. This is occasioned by the coagulating property of the mucilage, which, partaking of the nature of flour, has a tendency to run into paste, in proportion to the increase of heat applied, by which means it not only locks up a considerable part of the saccharum contained therein, but retains with it a proportionate quantity of the extracting liquor, which would otherwise

otherwise have drawn out the imprisoned sweet, thence lessening both the quantity and quality of the worts. And this has sometimes been known to have had so powerful an effect, as to have occasioned the *setting of the goods*, or the uniting the whole into a pasty mass; for tho' heat encreases the solvent powers of water, in most instances, there are some in which it totally destroys them. Such is the present of flour, which it converts into paste, besides those of blood, eggs, and some other animal substances, which it invariably tends to harden.

From a knowledge of these effects, we form our first ideas of the variations necessary in the heat of the extracting liquor, which are of more extensive utility than has been yet intimated, tho' exceedingly limited in their extent, from one extreme to the other.

The most common effects of too low a heat, besides sometimes producing immediate acidity, are an insipidity in the flavor of the beer, from a deficiency of those cha-

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characteristical qualities before mentioned; and a want of early transparency, from the superabundance of mucilaginous matter, extracted by such heats, which, after the utmost efforts of fermentation, will leave the beer turbid with such a cloud of its lighter feculencies, as will require the separation and precipitation of many months to disperse.

The contrary application, of too much heat, at the same time that it lessens the mucilage, has, as we have before seen, the effect of diminishing the saccharum also, whence that lean, thin quality observable in some beers; and by extracting an over-proportion of the oleaginous and earthy principles, renders the business of fermentation difficult and precarious, and impresses an austerity on the flavor of the liquor, which will not easily be effaced.

Yet the true medium heat for each extract, cannot be universally ascertained. An attention not only to the quality of the malt, but to the quantity wetted, is absolutely necessary, to the obtaining every
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due advantage; nor must the period at which the beer is intended for use, be omitted in the account. The quality of the water, also, claims a share in the consideration, in order to supply that deficient thinness and want of solvent force in hard, and to allow for the natural fullness and fermentative quality of soft; a particular to which London, in a great measure, owes the peculiar mucilaginous and nutritious quality of its malt-liquors; tho' it is not an improbable conjecture, that the water of the *Seine*, and of some other large rivers, on the continent, would produce similar qualities by similar application.

Although the variations above alluded to are indispensable, it is easy to conceive, from the small extent of the utmost variety, that they cannot be far distant; if, therefore, we know that a certain degree extracts the first principles in a certain proportion, we need not much consideration to fix upon another degree that shall produce the required proportion of
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the remaining qualities, and effect that equal distribution of parts in the extract, which it is the business of fermentation to form into a consistent whole.

Of Boiling

THE principal use of this operation, as it respects the worts particularly, is to separate the grosser or more palpable parts of the extract, preparatory to that more minute separation which is to be effected in the gyle tun. The eye is a very competent judge of this effect; for the coagulations or concretions into which the continued action of boiling forms those parts, are obvious to the slightest inspection, whilst the perfect transparency of the interstices of the worts, points out its utility in promoting that desirable quality in the beer.

In pursuing this observation, we have the satisfaction to find the preceding theory

theory of malt confirmed. The coagulating property of these parts, their superabundance in the first wort, especially from a low heat of liquor, the facility with which they form, and the superior bulk of the concretions in that wort, speak them to be parts of that farinaceous mucilage already explained; at the same time that the contrary appearances in the subsequent worts, their tardiness to concreate, and the very minute particles into which they form, in proportion to the abundance of the oleaginous quality extracted with them, evince the nature and existence of those other principles before described; for we find, by a common culinary practice, that an unctuous and an aqueous body may be so intimately united, by the interposition of flour, and the action of fire, as to become of a uniform consistence; which being then diffused in a larger body of boiling water, the coagulation of the flour, or the separation of the whole, would with greater difficulty be produced than if such union had not been.

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With respect to the utility of decoction in extracting the virtues of the hop, it may be necessary to recur to the consideration of that vegetable, in order to form some idea of the time requisite to the several intentions of extraction.

The fine essential oil of hops being most volatile and soonest extracted, we are thence taught the advantage of boiling the first wort no longer time than is sufficient to form the extract, without exposing it to the action of the fire so long as to dissipate the finer parts of this most valuable principle, and defeat the purpose of obtaining it. To the subsequent worts we can afford a larger allowance, and pursue the means of preservation so long as we can keep in view those of flavor, to which no rules can positively direct, the process varying with every variety of beer, and differing as essentially in the production of porter and that of pale ale, as the modes of producing wine and vinegar.

The consequence of not allowing a sufficient time for the due separation of the parts

parts of the wort, and extraction of the requisite qualities of the hop, is obvious from what has been already said; should we proceed to the other extreme, we have every thing to apprehend, from the introduction of too large a portion of the grosser principles of the hop, which are very inimical to fermentation, and from impairing the fermentative quality of the worts themselves, by suffering their too long exposure to the action of the fire passing thro' them, whereby they are reduced to a more dense consistence, and their parts too intimately blended to yield to the separating force of fermentation, with that ease the perfection of the product requires.

Of Fermentation.

THE general definition of fermentation is, *a spontaneous internal motion of constituent parts, which occasions a*

spontaneous

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Spontaneous separation and removal from their former order of combination, and a remarkable alteration in the subject, by a new arrangement and re-union.

This description is universal, and corresponds with the known effects of every species of the operation; but the particular kind to which our subject is limited, is the vegetable, which is again divided into the *vinous*, the *acetous*, and the *putrefactive*, forming a regular series or gradation, from the first origin of its action, to the total annihilation of the subject; or, as Dr. Shaw expresses it, “The intention or tendency of Nature, is to proceed from the very beginning of vinous fermentation, directly, in one continued series, to putrefaction, and thence again to a new generation; which appears to be the grand circle, wherein all natural things are moved, and all the physical, or rather chymical phenomena of the globe produced.”

It is not, however, the business of the artist to preserve this circle, but to break the

the chain of connection in such parts as may best answer the ends of his pursuit. Thus, the brewer is to stop the progress of the operation at the *vinous*, whilst the vinegar-maker pursues it to the *acetous*, beyond which every purpose of art is defeated.

The result of vinous fermentation is the production of that inflammable spirit which is no where to be found previous to this action, and in which alone the strength, or inebriating quality of beers consists. Hence it is evident, that in proportion as we conduct fermentation to that degree of perfection of which it is capable, we shall produce that desirable quality, and *vice versa*.

The only mode we are yet acquainted with, of proving the presence of this spirit, and determining the real strength of beers, is by distillation, which is not only the criterion of vinous fermentation, but the proof of its perfection or imperfection, by the quantity of spirit produced. By the same means is the acetous fermenta-

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tion distinguished, which so alters, conceals, or destroys the inflammable spirit, that the still only throws over an acid, unflammable, aqueous liquor; which seems to point out that regular progress to the annihilation of the whole, which putrefaction is to effect.

The principles produced by both these species of fermentation seem to be alike purely *etereal*; for they are so exceedingly volatile as to be in perpetual avolation, by the common heat of the air only; but their effects upon the human body are as widely different as those of the operations which produce them. That which results from vinous fermentation, being by the heat of the stomach thrown up into the head, produces intoxication; whilst that from the acetous, by a similar evaporation, insensibly pervades the vessels of the head, and exsudes thro' the pores of the skin, with extreme subtilty, in a visible but cold perspiration. Thus are we taught to draw the line of discrimination in a series of causes, from a knowledge of effects only;

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or, in other words, to determine the nature of the fermentation, from the quality of the principle produced.

The immediate succession of the three species, seems to be the consequence of continuing the subject in the same state; for vinous fermentation is no sooner completed, than the acetous commences, if the fermenting liquor be suffered to retain the same degree of heat; in which state being incapable of depositing its proper feculencies, their suspension and commotion in the body of the liquor, continue the action beyond the period of vinosity, and the acetous fermentation of necessity ensues; which by a similar continuation and exposure to the external air, would immediately produce the putrefactive, and proceed to the completion of that circle, in which all the labored combinations of Art, resolve into the first simple principles of Nature.

To mark the limits of distinction, and stop the progressive force of fermentation, at such a period as shall best answer the
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brewer's purpose, in the production of every practicable degree of spirituousity; and to conduct the action to that period, with every advantage to the subject, is a knowledge to be acquired not less from practical attention, than theoretical enquiries. It is our business here, only to assist the latter: the former requires an elucidation somewhat beyond the bounds of verbal instruction.

In the doctrine of fermentation, it is a maxim, that *such subjects as are most separable by means of water, air, and heat, have the greatest tendency to ferment*; accordingly we find that wort, or the extract of malt, abounds in fermentable matter, but varies in quantity, in proportion to the heat and quantity of the liquor employed, agreeable to our theory of extracts. This fermentable matter we also find distinguished into saccharine, mucilaginous, oleaginous, and earthy. An adequate proportion of each of these principles is necessary to a regular fermentation, and the production of a perfect, uniform beer.

A surcharge of either, by destroying the equilibrium, changes the mode of the action, disturbs the due arrangement of the parts, and produces effects agreeable to the nature of the predominating principle. These effects, however, are not equally prejudicial to the beer; for we find that a surcharge of the saccharine and mucilaginous parts, tho' it occasions that turbidity and rawness of flavor before-mentioned, is yet corrigible by time, and yields very readily to the action of precipitants; but an over-proportion of the oleaginous and earthy principles, besides the evils before enumerated, especially from the browner malts, is frequently productive of two of the most disagreeable qualities that ever disgraced the London brewery, where they have been particularly prevalent, and which time cannot correct, nor art effectually remove.

A due proportion of the fermentable principles being obtained, our next care is to collect the extracts into a body at such a degree of heat as will facilitate the action, and

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and to apply such a portion of a proper ferment, as shall regulate and conduct it to the desired period of perfection.

It is well known that the juices or extracts of all saccharine vegetables, have a natural and spontaneous tendency to ferment into a vinous liquor; this is also the property of wort, but the effects are not similar. The expressed juices of fruits, the saccharine sap of certain trees, &c. when collected into a body at a due degree of heat, of themselves produce a wine, without the addition of a ferment; but worts, being loaded with an abundance of a tenacious mucilage, without yeast to assist and accelerate the efforts of nature, would run into an irregular and imperfect fermentation, or rather would immediately commence that *tumultuary motion* of their component parts, which is said to produce putrefaction. This is, in a great measure, confirmed by the effect; for tho' we find that the action has been so far vinous, as to produce a small portion of inflammable spirit, yet the putrefactive has at the same time

time been so prevalent, as to render the whole body of the liquor fetid and nauseous in the extreme; a consequence often derived from suffering worts to remain too long, or in too large a body, without yeast, especially in warm weather, when they have a greater propensity to ferment in a body of a few inches deep, than they have in cold, at the depth of as many feet.

A proper application of yeast prevents this accident, and disposes the parts of the wort to that separation and new arrangement, on which the perfection of the product depends.

The quantity of fermentable matter, already in action, thus conveyed into the body of the wort, assists its spontaneous aptitude to ferment, and a violent struggle immediately ensues. The air contained in the yeast, being rarefied by the increased warmth it meets with in the wort, begins to break from its confinement, and escape at the surface, which is the first perceptible sign of fermentation. In the rapid progress of its particles, towards the top, a

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smart attrition and collision are occasioned, between those particles, the body of the wort they pass through, and the grosser parts, which are, by their gravity, in contra-direction. By this attrition the oleaginous parts of the subject are separated, (a property which air is peculiarly allowed to possess) and, being more subtile and disposed to elasticity, would be carried off with the air, were they not too intimately connected with and enveloped by the earthy, which are both too weighty to fly off, and too much inclined to collect and aggregate, by which means they at length, with the grosser mucilage, subside to the bottom, in the form of lees. But before this can be effected, by their adherence to the particles of air, to which they form a vehicle, they are rapidly carried to the surface, where the air bursting from them, the heavier fall down again towards the bottom, whilst the lighter are supported, by the continual efflux of air, till the successive bursting of bubble after bubble lets them down again into the liquor, and supplies,

plies their place with fresh matter. In their passage downwards, they are met by other innumerable particles of air, in the same rapid progress upwards, by which they are again carried to the surface, there to be left as before, till by repeated falling, collision, and attrition, some of the oleaginous particles are effectually separated from the earthy, and united with the saccharine, to which they have a natural tendency, as is evinced by the ready incorporation of common sugar and essential oils, by triture only, whence their miscibility with aqueous substances is effected:

This union is no sooner formed, than the continuance of the action proceeds to absorb the finer parts of the earthy principle, which is left floating up and down in the liquor, after its separation from the oleaginous; by which addition, and the intervention of the mucilage, that common medium, which fermentation rather tends to refine than disunite, the whole is converted into a compact and uniform body.

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The grosser parts having, by this violent commotion, been completely separated, and the finer recomposed, the more weighty of the former fall to the bottom, whilst the lighter, consisting principally of the refuse mucilage, are carried to the top, where, by their glutinous adherence to each other, being supported by the collected air, they form a yeasty head.

The action now languishes, the vinous fermentation is complete, and all that is wanting, is the prevention of the further progress of the operation, by dividing the subject into casks, where it soon becomes of less heat, by which means the heavier particles condense and effectually subside; the lighter, by the frequent filling up of the casks, are collected nearly to a point, at the bung-hole, where being thrown off, they fall down the side, and leave the beer completely purged of all matter which might [hereafter endanger a pernicious *stubbornness*, or destructive *fret*.

Were a confirmation of this doctrine necessary, we might perhaps find it in an
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attentive observance of the effects of fermentation, at different periods of its action. That the oleaginous and earthy principles are first struck out of the body of the wort, is evinced by its remarkably sweet flavor at that time, and the very gross, bitter austerity of the frothy head, which then contains the greater part of the unattenuated oils and earths; and that those principles do unite and incorporate with the saccharine and mucilaginous, in the latter part of the operation, is proved by the gradual alteration in the flavor of the liquor, from a mixed sweet to a uniform vinosity, and a similar change in the harshness of the yeasty head, which then assumes a like uniformity, so far as the term may be allowed to the aggregated refuse of so many different principles.

The agency of air, in the business of fermentation, is very powerful, but as all fermentable subjects have an abundant supply, we are rather to provide for the egress of their own, than to suffer the admission of the external air, by which a
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great number of the fine, volatile, oleaginous parts of the subject would be carried off, and a proportionate injury in flavor and spirituousity sustained. Hence such a covering should be provided for the gyle-tun as would barely allow the escape of the common air produced by the operation, whilst the *gas*, or fixed air, from its greater density, resting upon the surface of the beer the whole depth of the curb, prevents the action of the external air, and consequently the escape of those fine and valuable parts just mentioned.

This probable consequence is the more to be depended on, from the known similarity of effect which gas produces upon flame, which it immediately extinguishes, by preventing that rapid avolation of unctuous particles which is said to constitute flame. In this instance the external air is the agent, which causes and conducts the avolation, and without a continual supply of which it cannot exist; this supply being effectually cut off by an immersion of the subject in the gas of fermenting liquor,

liquor, the flame is instantaneously extinguished; nor will glowing fire itself exist in it a long time, tho' it contributes to rarefy and disperse it; and to animals inhaling it, a death as sudden as by a stroke of lightning is the consequence.

But towards the conclusion of vinous fermentation, this aerial covering begins to lose its efficacy, which points out the necessity of then getting the beer into casks, as soon as possible, that the consequences may be prevented, of exposing so large a surface, liable to so copious an evaporation. Amongst these, a loss of spirituousity is not the least; for this evaporation is more and more spirituous, as the action approaches the completion of vinous fermentation, and that once obtained, the loss becomes still more considerable, if still exposed to the air; whence it might be termed the distillation of Nature, in which she is so much superior to Art, that the ethereal spirit rises pure and unmixed, whilst the highest rectification of the still produces,

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produces, at best, but a compound of aqueous and spirituous parts.

Nor is this entirely conjecture. Experience teaches us, that we cannot produce so strong a beer in summer, *ceteris paribus*, as in winter; the reason is, not because the action of fermentation does not realize so much spirit in warm weather, but because the fermenting liquor, after the perfection of vinosity, continues so long in a state of rarefaction, that the spirituous parts are dissipated in a much greater degree at that time, than at any other, in a similar state of progression. And this doctrine of natural distillation seems to account for that increase of strength obtainable from long preservation, in well closed casks, and, more particularly so, in glass bottles; for Nature, in her efforts to bring about her grand purpose of resolving every compound into its first principles, keeps up a perpetual internal struggle, as well as an external evaporation, and if the latter be effectually prevented, the former must be productive of additional spirituousity,

tuosity, so long as the action keeps within the pale of vinous fermentation

In order to maintain a due regulation of the fermenting power, and to answer the several purposes of the operation, a scrupulous attention to the degree of heat at which the action commences, and a particular regard to the quality and quantity of the ferment employed, are indispensibly necessary.

The quality of the yeast requires the more minute scrutiny, because it is not possible to produce a perfect and effectual fermentation, without it be good, evinced by its lively, elastic appearance, and powerful effect in application. The quantity can only be ascertained, by the intention of the artist. In many instances, a larger portion is tantamount to a higher degree of fermenting heat, and *vice versa*; but this is chiefly confined to the purpose of accelerating the process. If the operation be too languid, from a want of heat in the fermenting liquor, an addition of fresh yeast may supply the deficiency, and effect

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the required recomposition of parts, without which there is not only an immediate loss of strength, but such a derangement of the preservative principles, as will effectually prevent their reunion, and leave the imperfect product to the certainty of early destruction. The action, in this instance, having only sufficient force to separate, and being unable to attenuate and recompose the oleaginous and earthy parts of the subject, the body of the beer remains a heavy, unconcocted farrago of the whole constituent principles, of a fulsome, sweet, mawkish flavor, prompt to a stubborn fret, on the first change of air, and consequent acidity, the final period of its existence as a vinous liquor.

This, also, leads us to the necessity of completing the vinous fermentation, previous to *cleansing*, or putting the liquor into casks, which change of quantity and situation, alters the action from fermentation to *purgation* only; for those parts which in the gyle-tun are carried to the top and repeatedly fall again into the body
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of the liquor, to be there further separated, attenuated, refined, and recomposed, are, in the cask, thrown off entirely, and perish in the *stillion*, or receiver, before they can be returned again, by filling up the vessel.

The consequences of such a violent disunion, have been before noted; to which may be added, the great loss of spirituoſity, occasioned by ſo premature a diſiſion of the fermenting liquor into ſmaller quantities, which immediately checks the operation, and prevents its being brought to a proper criſis, both from the preternatural diſcharge of the caſk, and the want of a ſufficient body to accompliſh that end; for it is not in the power of art to produce a proportionate quantity of ſpirit from a ſmall body of wort, to that which is obtainable from a large one, tho' of equal quality in every reſpect.

The effects of a contrary conduct, in ſuffering the liquor to remain in the tun after the period of vinous fermentation, have been already ſufficiently intimated;

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but the criterion which marks the exact period of maturity, resting more upon the discrimination of the senses, than an appeal to the understanding, we must leave to the illustration of practice, what lies beyond the documents of theory to define.

In these strictures, the *use of the thermometer* has been all along implied, without which all theory is ineffectual, all practice uncertain. We have seen that the variation of a few degrees of heat in forming the extracts, produces an important difference of effect. In the heat of fermentation, similar consequences result from similar variety. Under a certain regulation of the process, we can retain in the beer, as far as art is capable, the finer mucilage, and thereby preserve that fullness upon the palate which is by many so much admired; on the other hand, by a slight alteration, we can throw it off, and produce that evenness and uniformity of flavor, which has scarce any characteristic property, and is preferred by some, only for the want of that heaviness which they

they complain of in full beers. If a more vinous, racy *ale* be required, we can, by collecting and confining the operation within the body of the wort, cause the separation and absorption of such an abundant portion of the oleaginous and earthy principles, as to produce a liquor in a state of perfection at the earliest period, and so highly flavorful, as to create a suspicion of an adventitious quality.

Thus, by a judicious management of this most difficult and interesting part of the brewing process, we are enabled to influence natural flavor, spirituousity, and preservation. By a further improvement, we can introduce foreign virtues, (as in the instance of *porter*, &c.) anticipate age, and produce in two months the properties and characteristicks of twelve.

Of Cellarage.

THE disorders of the cellar are frequently mentioned among the grievances of the brewer, tho' they have in reality

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reality no existence. Every disorder in beers has its origin in the brewhouse, except those which arise from palpable neglect; such as the flatness occasioned by leaving the vessels unstopped, and the consequences arising from the use of a cellar so ill defended from the external air, as to expose the beer to every vicissitude of weather, from the extremity of summer's heat, down to the severity of winter's cold.

The former points out its own prevention, but its remedy must be sought in a fresh fermentation, artfully introduced, and moderately conducted. Upon the latter, as a particular often disregarded, a few thoughts may not be useless.

The temperature of the air to which beers ought generally to be exposed, for the purposes of perfect preservation, and the advantages of age, is that which equally avoids the two extremes, and is kept as uniformly invariable as the exclusion of either will permit. By Farenheit's thermometer we find the summer heat to be at 76 degrees, and the point of freezing at

at 32. Experience teaches us to adopt the intermedium, as the most certain means of avoiding the effects of that rarefaction and natural distillation before treated of, and the contrary consequences of advancing towards the opposite extreme of *concentration*, or freezing the aqueous parts of the liquor.

In proportion to the warmth of the air, as has been already intimated, the whole body is rarefied, the spirituous parts are thence more easily set at liberty, and their constant avolation encreased; by which a proportionate injury to the flavor, and a diminution of the strength are effected; for tho' the casks may be very well closed, the extreme subtilty of this spirituous evaporation will find means to pervade the head of the vessel, which in a warm, dry situation, is not a little disposed to favor the escape, whereas the humidity inseparable from a close, cool cellar, so saturates the wood as to render it, in a considerable degree, impervious to the flying vapor. Nor is this dissipation of spirituous parts thro'

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thro' the pores of the wood, to be deemed the chimera of conjecture. We have a confirmation in point, in the known effect of keeping distilled liquors in casks, which is an evident loss of strength, easily demonstrable by the hydrometer or hydrostatic balance; whilst those kept in glass, continue for years without any material alteration. But glass itself is insufficient for the purposes of the present occasion; because the increased heat of air excites a fresh commotion in the beer, which immediately proceeds to acidity, and the consequent mutation of the spirit, from an inflammable to an uninflam-
mable principle.

On the contrary, a degree of cold, as it approaches to the freezing point, by condensing, proportionally lessens that disposition to evaporate, but equally tends to concentrate the spirituous parts, which would actually happen, should the degree of cold be so intense as to freeze the liquor. In that case, the cold acts only upon the aqueous parts, beginning with those in
contact

contact with the vessel, and thence advancing towards the centre, forcing the spirituous parts inwards, till the concentrated liquor is of sufficient strength to resist an extreme degree of cold, as has frequently been instanced in the freezing of a cask of small beer, in the manner here treated of, to such a degree, that the liquor in the centre became of a quality equal to strong.

This is only quoted, in order to intimate the disadvantages of concentration, and, of course, all approaches thereto; for the aqueous parts being, by that means, gradually detached, become in a certain degree pure water; and it is notorious that water mixed with strong beer, as an occasional beverage, makes a disagreeable, flat, double-flavored liquor. The effect of concentration, if not equal, is similar, as would be experienced on the first change of air of sufficient warmth to set these aqueous or perished parts at liberty to reunite with the concentrated liquor; and tho' this accident could scarce ever happen to a person but moderately attentive to his

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business, there are some who approach too near the cause of it, to be entirely unaffected by the consequence.

Of the two extremes, an inclination to the latter may be least prejudicial, as only tending to a separation, which it is in the power of a new fermentation to rectify, whilst the effects of the former are, a dissipation of the more valuable parts, and a disposition of the remainder to inevitable destruction.

To pursue this subject beyond its present limits were to exceed the purpose of the author, who reserves the further elucidation of his theory for the personal application of those who wish to be more fully informed, by the convincing arguments of practical confirmation, and the corroborating testimony of facts.

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